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A PROSPECTIVE COMPARATIVE STUDY OF A SUBTROCHANTERIC FRACTURES TREATED WITH LONG PROXIMAL FEMUR NAIL AND PROXIMAL FEMUR LOCKING PLATE.

Orthopaedics

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ABSTRACT

Subtrochanteric area is usually described as the region from the lesser trochanter to 5cm distal of proximal femur. Fractures occurring in the area between the isthmus of the femoral canal and the lesser trochanter are considered subtrochanteric fractures.Surgical treatment for these types of fractures is a tough orthopaedic task. Our main objective of this prospective case series is to find out which is the better surgical treatment options between the long proximal femur nail and proximal femur locking plate in treatment of subtrochanteric fractures. In this study we have recruited 20 patients of subtrochanteric fractures who came to Sree Balaji Medical College And Hospital, Chennai from January2016 to December 2018.10 cases were treated with Proximal femur locking plate and 10 cases were treated by long Proximal femur nail. We found out that in this case series that PF-LCP had severe blood loss and operating time was more compared to those managed by long PFN. Out of 10 cases managed by PF-LCP 8 cases went for sound union, 2 cases went for non union requiring bone grafting and later went in for union. In 10 cases surgically treated with long PFN 9 cases went for sound union, 1 case had non union which require bone grafting and later went in for union. We came to a conclusion that long PFN is superior option for surgical management of subtrochanteric fractures than PF- LCP because long PFN has lesser operating time, much faster than PF-LCP and also has lesser interoperative blood loss.

KEYWORDS

Subtrochanteric fracture, long proximal femur nail (long PFN), proximal femur locking plate (PF-LCP), Intramedullary locking nail.

INTRODUCTION:

Subtrochanteric area is generally the region extending from the lesser trochanter to 5cm distally of proximal femur as described by Fielding[1]. Fractures occurring in the area between the isthmus of the femoral canal and the lesser trochanter are considered subtrochanteric fractures . Sometimes the fractures can expand to the proximal area i.e. femoral neck or trochanteric region, or distal area i.e. diaphyseal region of the

femur[1, 2]. Sub-trochanteric fractures was initially described by Boyd and Griffin as a variant of peritrochanteric femoral fractures with a high incidence of unsatisfactory results, surgical treatments of these fractures persist to be an orthopaedic challenges.

A report in 2004 in India estimated 600,000 osteoporotic hip fractures as an annual incidence[3]. Hip fractures have been one of the significant cause of mortality and morbidity in elderly patients and approximately 10- 30% peritrochanteric fractures are accountable[4].There are several predisposing factors for subtrochanteric fractures like it is mainly seen in elderly patients mostly because of osteoporotic or osteopenic factor. In younger age category, it is mostly because of high velocity trauma.

The subtrochanteric femur area or anatomy has a unique character. This area has a very high stress focus, and due to the insertions of muscles in this region, it is put through many distorting forces like flexion by the iliopsoas muscle, abduction by the gluteus medius muscle, and external rotation by the external rotators of the proximal femur fragments. The adductors are inserted in the distal region of the femur which causes the varus deformity[2,5] . Since this area is made up of a large cortical bone, the vascularization is more uncertain in subtrochanteric area than the transtrochanteric zone, which makes the union of the fractures unfavourable.

Subtrochanteric fractures are known to be accompanied with higher rates of malunion and non-union compared to other femoral fractures. If there is no medial support in some complex fractures patterns have an increase rates of fixation failure and resurgery[2].The non-surgical treatment modalities for subtrochanteric fractures causes delay in return to their functional activities, which will increase the morbidity and mortality caused by the extended periods of immobilization. If needed the conservative line of treatment of subtrochanteric fractures of the femur is only indicated in patients associated with serious co-morbidities that is contraindicated for anesthesia or surgical procedures[6]. Since the mortality from these fracture are very high it is necessary for early surgical intervention and make the patients early mobile as soon as possible because on immobilization it might lead to long term complications like bed sores, deep vein thrombosis, lung infections etc.

The two surgical modalities in the management of these fractures were chosen for this study, one is the cephalomedullary Nailing (Long PFN) and Proximal femur locking compression plates (PF-LCP). Other options were dynamic condylar screw, dynamic hip screw, angular blade plates. All these implants have its own pros and cons. Proximal femur locking compression plates (PF-LCP) have become popular over the last decade because of its shape which is pre-contoured and it also provides a three dimensional fixation for a better mechanical advantage and also have a gross angular stability with locking screws in the head of the femur with preserving the bone stock bone [7-12]. The lateral trochanteric wall is also stabilized by it acting as a buttress. Long PFN implant devises are positioned nearer to the mechanical axis of femur and therefore is subjected to less bending moment when compared to laterally placed Proximal femur locking compression plates[13].

MATERIALS AND METHODS:

All the patients had given a written consent for publishing their clinical and radiological data and appropriate clearance was obtained from the institute's research and ethical committee.

Our main aim of our study is to assess the efficacy, radiological and functional outcomes by using long Proximal femur nail and Proximal femur locking plate in the management of subtrochanteric fractures. This is a prospective case series study of subtrochanteric fractures presenting to the Department of Orthopaedics at Sree Balaji Medical College And Hospital, Chennai from January 2016 to December 2018. Recruitment of cases stopped in December 2017, so that the follow up time is for a minimum of 12 months, while the recruitment of patients was for 24 months. We have taken 20 cases of subtrochanteric fractures. 10 cases were treated with proximal femur locking plate and 10 cases were treated with long Proximal femur nail.

Inclusion criteria:

- Both male and female in age group of 20 to 69 years were included in the study.
- Injury within 14 days.
- Closed subtrochanteric fractures. Exclusion criteria:
- Patients not fulfilling the above inclusion criteria were excluded.
- Any patients with serious co-morbidities that is contraindicated

for anesthesia or surgical procedures
- Pathological fracture of subtrochanteric region were excluded.
- Open subtrochanteric fractures.
- Injury more than 14 days.

SURGICAL PROCEDURE FOR LONG PFN

Patient was worked up for surgery by doing all pre-surgical investigations. Anaesthetic fitness for surgery was obtained. Consent for surgery from patients own language was taken. Patient was taken under spinal anaesthesia .Patient in supine position ,the operated limb was on fracture table. The normal limb was flexed , abducted and externally rotated. Under C-ARM guidance reduction was tried by closed method traction adduction and internally rotating the operating limb. If reduction was found to be difficult then fracture site was opened via lateral approach as described below under surgical procedure for PF-LCP. An anatomic reduction of the fragments was achieved using Schanz screw which was placed into one of the proximal fragments or bone clamps after opening the fracture site. Usually the incision will be around 3 cm to 4 cm, made from the proximal tip of greater trochanter. Subcutaneous tissue and deep fascia was incised along the lines of skin incision. Gluteus maximus muscle was split.. The greater trochanter tip was palpated for using as a anatomical landmark for making an entry point which was usually the tip of trochanter or just medial to the greater trochanter tip . A 3.2mm guide wire is inserted through the entry point and is driven distally. Serial reaming was done passing along with the guide wire. The nail which closely matches to the neck shaft angle of the unaffected hip is assembled on the Jig.

The nail was secured over the Jig and negotiated through the entry point and further passed distally to the medullary canal to accommodate the proximal two screws into the femoral neck and fixed with lag screw, derotational screw and distal locking bolt under C-ARM guidance. Final fracture reduction with long PFN was checked after release of the traction from the traction table.

SURGICAL PROCEDURE FOR PF-LCP (Proximal Femoral Locking Compression Plate)

Patient is positioned in supine on the fracture table. Traction was given and satisfactory reduction and alignment was tried under C –arm guidance via Lateral approach fracture entry was made. A 10-15 cm longitudinal incision was done from 2 cm below the greater trochanter tip. Skin and subcutaneous tissues was dissected, the fascia of the vastus lateralis muscle was split and the muscle was retracted and fracture site was visualized. Fracture was reduced using bone holding forceps and checked under C- ARM guidance. the plate was placed on the lateral aspect of proximal femur and temporarily fixed using K wires and fixed with cannulated screw 7.3 mm for the two proximal holes and 5.0 mm for the third proximal hole until they have satisfactory subchondral purchase. The plate is then secured to the distal shaft with minimum cortical screws of 4.5mm (6 cortical purchases).

POST OPERATIVE PROTOCOL:

Post operatively patient was given antibiotic coverage from IV third generation cephalosporin for a week followed by oral antibiotics till suture removal. Most of the patients had epidural analgesic for the first 2 post operative along with parenteral analgesics. Regular dressing was done on POD 2 along with drain removal and on POD

5. On POD 12 suture removal was done. Exercises mainly of Static and quadriceps strengthening and physiotherapy was started on POD2. Non weightbearing with walker support was started on POD2 as long as patient tolerated pain for both the cases treated by long PFN and PF-LCP. Radiological evaluation was done on 7th week and then every month till the evidence of callus formation is seen followed by at 6 months and 1 year. Full weight bearing was commenced depending upon the radiological evidence of fracture

CASE ILLUSTRATION: OF LONG PFN

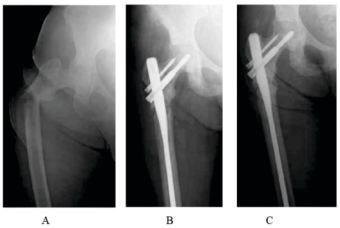

Figure 1 A showing x-ray preoperative subtrochanteric fracture, B showing of long PFN insitu post operative x-ray, C showing x-ray after 5 months post operated.

CASE ILLUSTRATION: OF PF-LCP

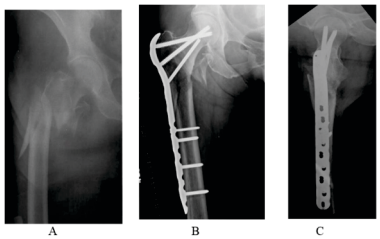

Figure 2 A showing preoperative x-ray showing subtrochanteric fracture, B showing postop x-ray with implant insitu, C showing x-ray with fracture union.

RESULTS:

TABLE 1: AGE AND SEX DISTRIBUTION.

Age (In Years)	Male 'N' (Percentage)	Female 'N' (Percentage)
20-29	-	1
30-39	1	1
40-49	2	2
50-59	1	2
60-69	4	6
Total	8(40%)	12(60%)

TABLE 2: PATIENT'S DEMOGRAPHICS.

CHARECTERISTICS		"n"	Percentage %
GENDER	MALE	8	40
	FEMALE	12	60
SIDEDNESS OF FRACTURE	LEFT	11	55
	RIGHT	9	45
MODE OF INJURY	RTA	13	65
	SLIP AND FALL	7	35

TABLE 3: SURGICAL MODALITIES PERAMETERS.

	OPEN REDUCTION 'N'(PERCENTAGE)	CLOSED REDUCTION 'N'(PERCENTAGE)	OPERATIN G TIME (average min)	BLOOD LOSS (average ml)	AGE (mean)
long PFN	4(40%)	6(60%)	90 min	82	49.10
PF-LCP	10(100%)	-	120 min	160	56.30

TABLE 4: BONE UNION CHARECTERISTICS.

	UNION 'N'(PERCENTAGE)	NON UNION 'N'(PERCENTAGE)	TOTAL
Long PFN	9(90%)	1(10%)	10
PF-LCP	8(80%)	2(20%)	10

TABLE 5: PERIOD FOR FRACTURE CONSOLIDATION.

TIME IN WEEKS	long PFN 'N'(PERCENTAGE)	PF-LCP 'N'(PERCENTAGE)
10-13	1(11.1%)	-
14-17	6(66.7%)	2(25%)
18-21	2(22.2%)	5(62.5%)
22-25	-	1(12.5%)
TOTAL	9	8

In the 24 months of recruitment, we could enrol 20 patients who satisfied our inclusion criteria. Of these 20 patients majority were female patients of 60%(n=12) and 40%(n=8) were male patients. There was a preponderance of left sidedness of the fracture. In our series majority of the patients 50% (n=10) where in the age range of 60-69 years. There were 34% (n= 7) in the age range of 40-59 years and the least 15% (n=3) were from 20- 39 years. In regarding the average age(mean) for long PFN patients were 49 years and for PF-LCP were 56 years. 65% (n=13) majority of the cases had an history of an road traffic accident and remaining 35% (n=7) had history of slip and fall. In total of 20 cases 15%(n= 3) cases went for non union out of which 2 belonged to the PF-LCP group and 1 belonged to the long PFN group. All 3 cases ultimately went on bony union subsequent to autologous bone grafting.

In terms of fracture union, cases treated with long PFN went on for early union constituting 66.7%(n=6) by around 14 to 17 weeks. 1 case which resulted into union by 13 weeks was aged 20 years. In most of the cases 62.5%(n=5) treated with PF-LCP average time taken for bone union was between 18 to 21 weeks with an average of 19.5 weeks and none of the PF-LCP cases showed union less than 14 weeks after surgery.

Intraoperatively blood loss and time taken was less in long PFN cases of an average of 90 min and 82ml blood loss compared to PF-LCP cases had 120 min operating time with 160 ml blood loss.

DISCUSSION:

Fractures of subtrochanteric femur have been considered as a one of the major challenges to come across by any orthopaedician due to its high morbidity and mortality to the patients. An orthopaedic surgeon's main aim is not only to bring about fractures union, but also to restore the optimal functioning in the least period of time along with minimal complications to his patients. To achieve early mobilization with quick return of patients day to day activity surgery is needed in subtrochanteric fracture management but not by any other conservative or non surgical methods except in cases were patients have serious co-morbidities that is contraindicated for anesthesia or surgical procedures. These subtrochanteric fractures take a longer time to unite due to its deforming forces acting around it.

There is still a confusion regarding the best implant to use in treating these type of fractures [14]. Certain modality used in the management of these fractures are dynamic condylar screw, dynamic hip screw, plate screw systems, intramedullary interlocking nails etc., which have their own benefits and drawbacks. Since long PFN and PF-LCP are the most frequently used mode of treatment used today we have taken up this case series to find out which out of the two gives better clinical and functional outcomes.

Long Proximal Femoral Nail or long PFN is an intramedullary nailing device is a load sharing device which carries most of the bending loads. It also has a minimally open approach and is closely connected to "biological internal fixation" it also has other benefits over plate fixation like long PFN also allows the orthopaedic surgeon to have less soft tissue trauma or dissection and hence reducing the fracture hematoma loss and helps in faster bone union. There will be lesser chance of infection, blood loss and other wound complications[15]. There can be difficulties like closed fracture reduction due to the major muscular forces acting around the sub trochanteric region which causesignificant displacement of the fractured fragments. Sometimes open reduction through a small incision at the fracture areas is needed.

Delayed union and non-union are the other complications of these fractures which have been said to be 1-10% in certain studies[16-22] as same as our study which is only 10% compared to extramedullary plate fixation which are high. Johnson et al; [23] reported 41.4% failure rates of which 83% patients were elderly females. Gunadham et al; [24] described 23% failure rate in an analysis comparing 26 patients with sub-trochanteric fractures which showed 1 non-union, 1 broken screw, 2 broken plates and 2 varus collapse. Glassner et al; [25] case series had 10 patients with 70% i.e 7 cases of implant failure complications, 2 cases had broken screws, 2 cases had broken plates, 3 implant cut-out cases. In this prospective study there were no implant related complications compared to the 11% seen in the study by Menezes et al; [26] .In this study fixation failure occurred in 3 patients(2%), which includes one cut out, one delayed union, 1 had lateral displacement of antirotation screw (total 155 cases) [27].

The most crucial factor any case treated with long PFN is the surgical technique, an ideal entry point and reduction is the key. Paulo Roberto Barbosa and Streubel et al;[28] have given that the entry point most ideal was just medial to the greater trochanter tip in 70% of the cases and lateral in 30% of the cases.

Lag screw should be applied to the inferior part of the neck of the femur close to the calcar in anteroposterior view and right in the central in lateral view.[29,30]. The screw tip should reach the subchondral bone, 5-10 mm beneath the articular cartilage. Miedel et al;[31] observed that long PFN cases has the rate of reoperation of 23% if there were no proper reduction of the fracture whereas those with good reduction, no patients were reoperated. To restore the cervico diaphyseal angle should also be our aim along with the correction of the rotation and flexion of the proximal fragment.

A defined mechanical complication of long PFN is the cut – out of the screw, which by Werner et al;[32] describes Z-effect. As there is a varus collapse of the fracture, there is a migration laterally of the inferior screw. There is also a superior screw tendency to perforate the femoral head. This ensues when weight bearing is initiated. Boldin et al;[33] described the reverse Z-effect where in there is an outward migration of the superior screw and inward migration of the inferior screw. This necessitates early implant removal.

The one of the main factors for stabilizing subtrochanteric fractures is the lateral trochanteric wall.[34] by keeping the lateral wall intact or stable will help in fracture union and also reduce the malunion or nonunion rates [35] this device proximal lateral femur locking compression plate (PF-LCP) will help in reducing the stress over the lateral trochanteric wall and prevent the lateral displacement of the proximal fragments.

Hasenboehler EA et al; said this kind of an device may be an option for transverse intertrochanteric or subtrochanteric fractures[36] . Gotfried Y et al; said an intact lateral wall plays a vital role in the fixation and stabilization of the unstable peritrochanteric hip fractures, which is even more crucial than the implant placement such as TAD (tip apex distance)[37]. Some times there can be lateral trochanteric wall fracture during reaming for the insertion of the intramedullary nails or DHS screw in the head of femur [38] . When the lateral wall is no more intact it act as a buttress and medialization occurs which is likely to fail. If using PF-LCP one of the most crucial factor is the plate positioning and screw placement.The proximal tip of the plate should engage with the greater trochanter tip and the plate with increased length spanning the whole fracture are more reliable.

Inferior most head screw should engage the calcar and proximal screws should be as long as possible.

CONCLUSION:

In this prospective series we came to a conclusion that the long PFN has more advantages as compare to PF-LCP taking into faster fracture union rates, less blood loss and also gives early mobilization to the patients. Even though we came across less complications between the two devices, long PFN has an upper hand since it acts more as a fracture stabilisation device.

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